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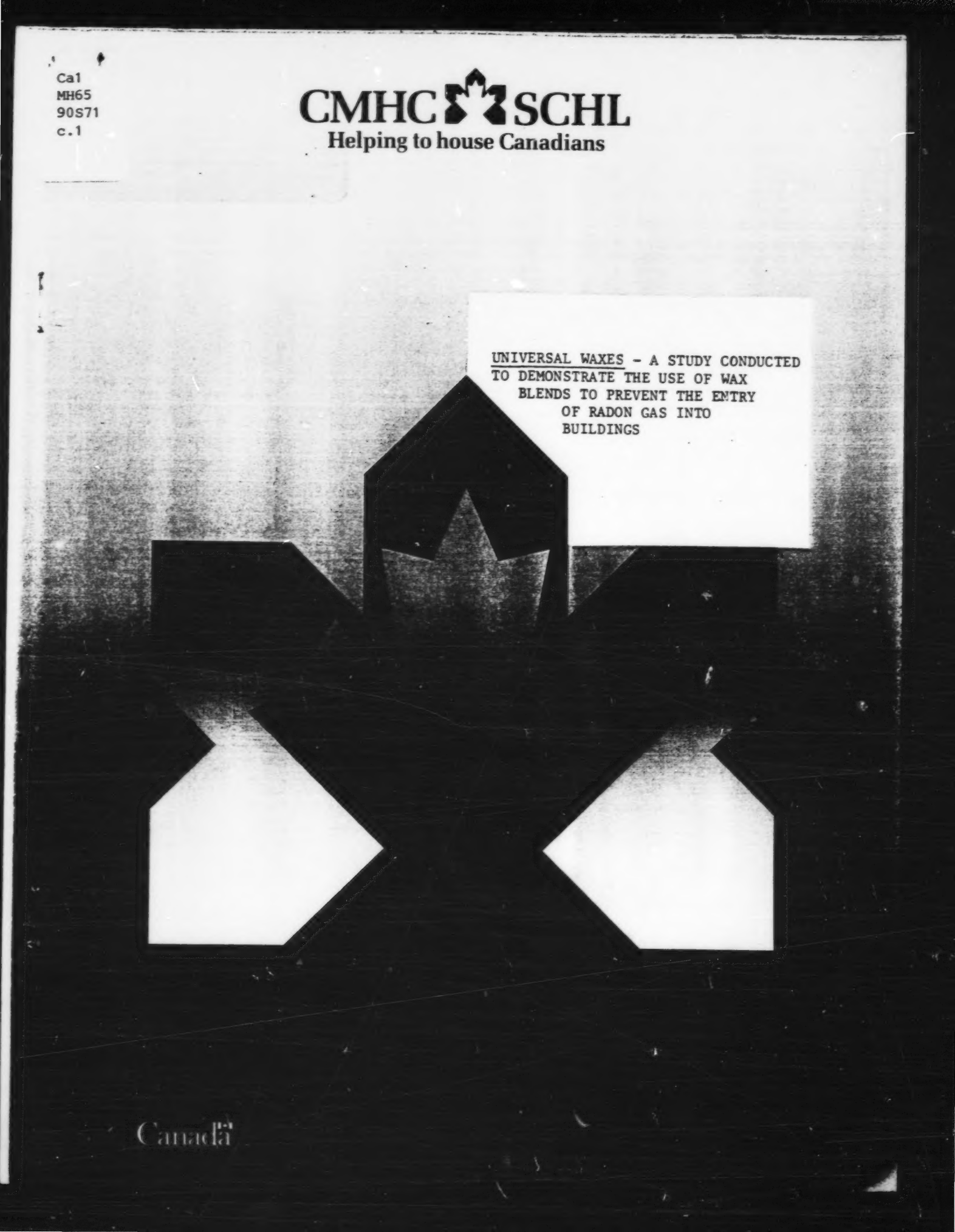
UNIVERSAL WAXES - A STUDY CONDUCTED TO DEMONSTRATE THE USE OF WAX BLENDS TO PREVENT THE ENTRY OF RADON GAS INTO BUILDINGS



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UNIVERSAL WAXES - A STUDY CONDUCTED TO DEMONSTRATE THE USE OF WAX BLENDS TO PREVENT THE ENTRY OF RADON GAS INTO BUILDINGS

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Canada Mortgage and Housing Corporation
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Canadian Housing Information Centre
Centre canadien de documentation sur l'habitation

OCTOBER 31, 1990

This project was carried out with the assistance of a grant from Canada Mortgage and Housing Corporation under the terms of the Housing Technology Incentives Program (HTIP). The views expressed are those of the author and do not represent the official views of the Corporation.

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A STUDY CONDUCTED BY UNIVERSAL WAXES

TO DEMONSTRATE THE USE OF WAX BLENDS

TO PREVENT

THE ENTRY OF RADON GAS

INTO BUILDINGS

PHASE III

OCTOBER 31, 1990

Author: William E. Nelson

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ABSTRACT

Universal Waxes has developed a product which can seal basements from moisture and soil gas infiltration.

The sealant is a new product which can clog porous surfaces such as pitted concrete, and block the entry of radon gas. Only one application is necessary and no maintenance is required. This wax sealant remains flexible and is uneffected by differential movements. Its bonding ability allows it to adhere to porous surfaces such as concrete. It is clean and non-biodegradable and is a preservative to materials unto which it is applied. It will penetrate deeply into hairline cracks and floor/wall joints or fill large cracks and unwanted openings in concrete walls and floors.

The product meets strict requirements of the Canadian Food and Drug Act and it can be made to repel insects and prevent larvae incubation.

Tests conducted by Universal Waxes between October 1989 and June 1990 with the assistance of a grant from Canada Mortgage and Housing Corporation has shown the sealant to perform well and reduce radon gas to acceptable levels in three Eastern Ontario homes.

1) EXECUTIVE SUMMARY

Universal Waxes received approval for the project described herein from CMHC in October 1989. The project's purpose was to test the potential of a blended wax product to seal basements of existing homes against the entry of moisture and soil gases, particularly Radon Rn222.

Universal Waxes retained the services of Radon Analysis of Ottawa-Carleton, an independent and experienced consultant, to select residential units known to have significant levels of radon gas.

During Phase I of the project, Radon Analysis of Ottawa-Carleton measured levels of radon gas over 24 hour periods in a number of residential units in the Ottawa area. It was determined that mitigation of radon gas was warranted in three of the units where initial readings ranged from 2.4 pCi/L to 16.3 pCi/L. Moisture was not a problem in any of the three units. Cracks, electric service entries, wall/floor joints, air vents, sumps, jack posts, drains, septic outlets and a variety of apertures such as pitted concrete were identified as possible points for radon gas entry. All points of entry were documented, cleaned of dust, dirt and debris and prepared for sealing.

In Phase II, and prior to sealing, a variety of wax blends were tested. Three of the most effective blends were applied, one to each unit, to all identified entry points using a variety of methods. The application methods included: (a) pouring in a liquid state, (b) using a caulking gun and sealing with heat, (c) packing and troweling by hand and sealing with heat.

One of the units was successfuly treated after the first sealing session and one of the units required a second sealing session. Radon Gas measurements taken on March 23 and 28 showed Units #2 and #3 to have reductions from 2.4 to.02 pCi/L and from 4.1 to .61 pCi/L, respectively. Measurements taken on June 19 & 25 recorded readings of .02 pCi/l and .93 pCi/L respectively for Units #2 and #3.

Many return trips were required to Unit #1 as new entry points were repeatedly found. Radon Analysis of Ottawa-Carleton was instrumental in discovering the new sources of radon entry in this home. Radon measurements taken over 24 hour periods for several days during March 1990, showed continued improvements as each new entry point was sealed. Readings on March 24 showed that the original level of 16.3 pCi/L was

reduced to 4.4 pCi/L in this, the most challenging of the three homes.

Although this represented a 73% reduction in Unit #1, the initial objective was to reach a level below 4 pCi/L. Additional sealing was undertaken and more readings recorded. The final 24 hour Radon measurements were taken on June 19, 1990. The most difficult home had a dramatically reduced level of radon gas with a reading of 2.4 pCi/L.

Radon levels fluctuate according to environmental conditions, however it is with confidence that we state that the wax sealant, product of Universal Waxes, accounted for the significant reduction of radon gas readings in the three demonstration units.

Although this product has good, potential use in existing homes, the application can be labour intensive. The most advantageous and effective employment of this wax product would be in new home construction - before the wall/floor joints are obstructed with concrete and finished flooring, for example.

2) BACKGROUND

The presence of Uranium in the Earth's soil indicates the release of radon into the atmosphere which infiltrates into buildings with basements.

The development and implementation of reliable protection against radon gas would provide significant health benefits to people living and working in buidlings in areas where high levels of radon occur.

Universal Waxes has previously investigated the use of wax to seal radioactive wastes and uranium mine tailings.

3) OBJECTIVES

The major intention of this study was to test a wax product that would completely seal basements of dwelling structure against the entry of moisture and noxious soil gases, particularly radon gas. Also, it was hoped that the opportunity to perform a successful test would bring the product and the process to the attention of regulating agencies and the building industry.

4) UNIT DESCRIPTIONS

Unit #1 - Meech Lake, Quebec

The unit measured 46' by 46' and had a full basement with 8' ceilings and concrete floor and walls. Some of the walls were finished with drywall and plywood and some of the floor was carpeted. A gas mask was required during sealing in two sections of the basement because of the enormous amount of dust particles in the sealing area.

The main entry points of radon gas were: 1) air vents used for heating and air conditioning; 2) floor/wall joints; 3) gap around septic outlets; 4) unused drains; 5) electric service entries; 6) several cracks, one in the concrete wall and a number on the floor; 7) water service entries. (see Appendix I - Drawings)

All the vents in this unit led off an 8 inch diameter furnace duct. The vent pipes were built under the slab and were in contact with the soil beneath the slab causing them to rust and allowing radon gas to enter the home. Four 4" vent pipes extended under the floor and across two main rooms of the basement. All pipes were corroded and rusted. (see Appendix II - Photos, plate 1 & 2)

The four vents were first sealed with concrete and once cured, sealed again with liquid wax in order to fill the hairline cracks caused by the shrinkage of the concrete. The 8 " pipe was removed from the furnace and the hole where the pipe entered the floor slab was also sealed with concrete and the wax sealant.

Wall-to-wall carpeting had to be ripped out to gain access to unused drains and floor/wall joints (plate 7, +8 & 9). Sections of the finished walls had to be cut out to expose the floor/wall joints behind the studs (plate 11 & 12). All deteriorated caulking was removed from all the floor/wall joints and all joints around the perimeter of the entire building was sealed, first using hot liquid wax and finished with a cold semi-solid wax (plate 8 & 19). Two of the unused drains under the carpet were sealed with a semi-solid wax cap. These caps could be removed if needed (plate 14).

The gap around the two septic pipe outlets were packed by hand with a cold wax and then fused to the concrete with a propane torch (plate 13).

The space around the electric wire in the connector boxes and the punched out plugs were sealed by packing with semi-solid wax. The same application was used to seal the spaces around the water pipes entering the concrete walls.

The single crack on one wall and several cracks on the floor near the stairwell were sealed with liquid wax and made smooth with the use of a propane torch and a putty knife (plate 16).

Six trips over a 9 month period were made as new entry points, such as cracks and drains, were discovered by the homeowner and Radon Analysis of Ottawa-Carleton. These return trips were made to ensure complete sealing.

Unit #2 - Gloucester. Ontario

This unit measured 16' by 32' and had a full basement with 8' ceilings, painted concrete floor and half studded walls. This basement was very clean. Two trips were made to this unit to ensure complete sealing.

The main entry points for radon gas were: 1) drains; 2) septic outlet; 3) electrical outlet; 4) water entries; 5) floor/wall joints; 6) pitted walls and 7) jack posts. (see Appendix I - Drawings)

Two drains were sealed with semi-solid wax caps which could be removed by hand when needed. The gap around the septic pipe outlet was packed by hand with a cold wax and then fused to the concrete with a propane torch.

The space around the electric wires in two connector boxes was sealed by packing with semi-solid wax. The same application was used to seal the spaces around the water pipes entering the concrete walls.

The gap of approximately 1/4" to 3/8" in the floor/wall joints around the perimeter of the entire building was sealed, first using hot liquid wax sealant and finished with a semi-solid wax (plate 1 & 2).

The walls that were pitted were packed with semi-solid wax and made smooth with a propane torch and putty knife (plate 3).

Liquid wax was poured into the adjustment holes of three jack posts to form a seal at the base of the posts below the concrete slab. The posts extended below the concrete slab into the soil beneath the slab (plate 6 unit 3).

Unit #3 - Kemptville, Ontario

This unit measured 50' by 30' with a full basement and 8' ceilings. The floor and walls were unpainted concrete with some walls partially studded. (see Appendix I - Drawings.)

The main entry points for radon gas were: 1) drain; 2) electrical outlets; 3) floor cracks; 4) water entry; 5) jack posts; 6) floor/wall joints and 7) sump.

The drain was sealed with a semi-solid wax cap which could be removed by hand when needed.

The space around the electric wires in two connector boxes was sealed by packing with semi-solid wax. The same application was used to seal the spaces around the water pipes entering the concrete walls.

Floor cracks were sealed with liquid wax and made smooth with a propane torch and putty knife (plates 7, 8, 9 & 10).

Liquid wax was poured into the adjustment holes of five jack posts to form a seal at the base of the posts below the concrete slab. The posts extended below the concrete slab into the soil beneath the slab (plate 6 unit 3).

The gap in the floor/wall joints around the perimeter of the entire building was sealed, first using hot liquid wax and finished with a semi-solid wax.

The sump of corrugated steel was 18" in diameter. The rim of the sump hole was built up with semi-solid wax and the sump cover was pressed onto the wax and sealed using a propane torch (plate 1, 2 & 3).

5) ASSESSMENT AND PERFORMANCE

No moisture was noticed before or after the sealing. All three wax blends performed as anticipated (see Appendix IV - Product Data). The wax sealants adhered to the surfaces to which they were applied. No changes were noticed in the characteristics of the wax during the 9 month test period. Differential movements caused by weather changes and human activity did not affect the ability of the wax to adhere. The wax remained flexible and fixed in place. No corrosion or decomposition was observed. The repeated test results from Radon Analysis of Ottawa-Carleton showed radon gas levels were consistently reduced throughout the testing period, indicating that migration of radon gas was prevented. (see Appendix III - Raw Data).

6) ASSESSMENT AND INTERPRETATION

The test results were convincing. However, the Meech Lake home was very labour intensive and was not an ideal test unit to show the potential of the wax product as it may be used in homes that conform to standard building codes. A great deal of effort went into carpentry and masonry work which prolonged the testing.

7) CONCLUSION

The major project objectives were met and the test was successful. However the application of the wax sealant while using a caulking gun proved difficult as the wax had to be heated in order to extrude consistently. It would have been easier if the formula had been more viscous. This can be achieved by formulating a lower melt point wax. The lower melt point wax would also increase the penetration into the floor/wall joints. Another product improvement might include the addition of citronella oil which would give the product the ability to repel insects and prevent larvae from incubating in damp areas.

The wax product would be of a major benefit to the building industry because of its low cost to manufacture, ease of application and maintenance free properties. It is resistant to erosion, corrosion, or biological decomposition. Each of the wax blends used is pure and meets strict Canadian Food and Drug Act requirements (see Appendix IV - Raw Data). This method of protecting basements from soil gas leakage is less expensive than other methods presently being used. The

raw materials (wax) used in the sealant blends cost approximately $1 a pound.

Universal Waxes requests that CMHC consider the test results with a view to recommending the use of this wax sealant. Preventing the infiltration of radon gas both in existing homes, but particularly in new home construction would be a significant achievement.

We are grateful for the opportunity to have conducted this project and offer our further services to CMHC should additional testing be appropriate..

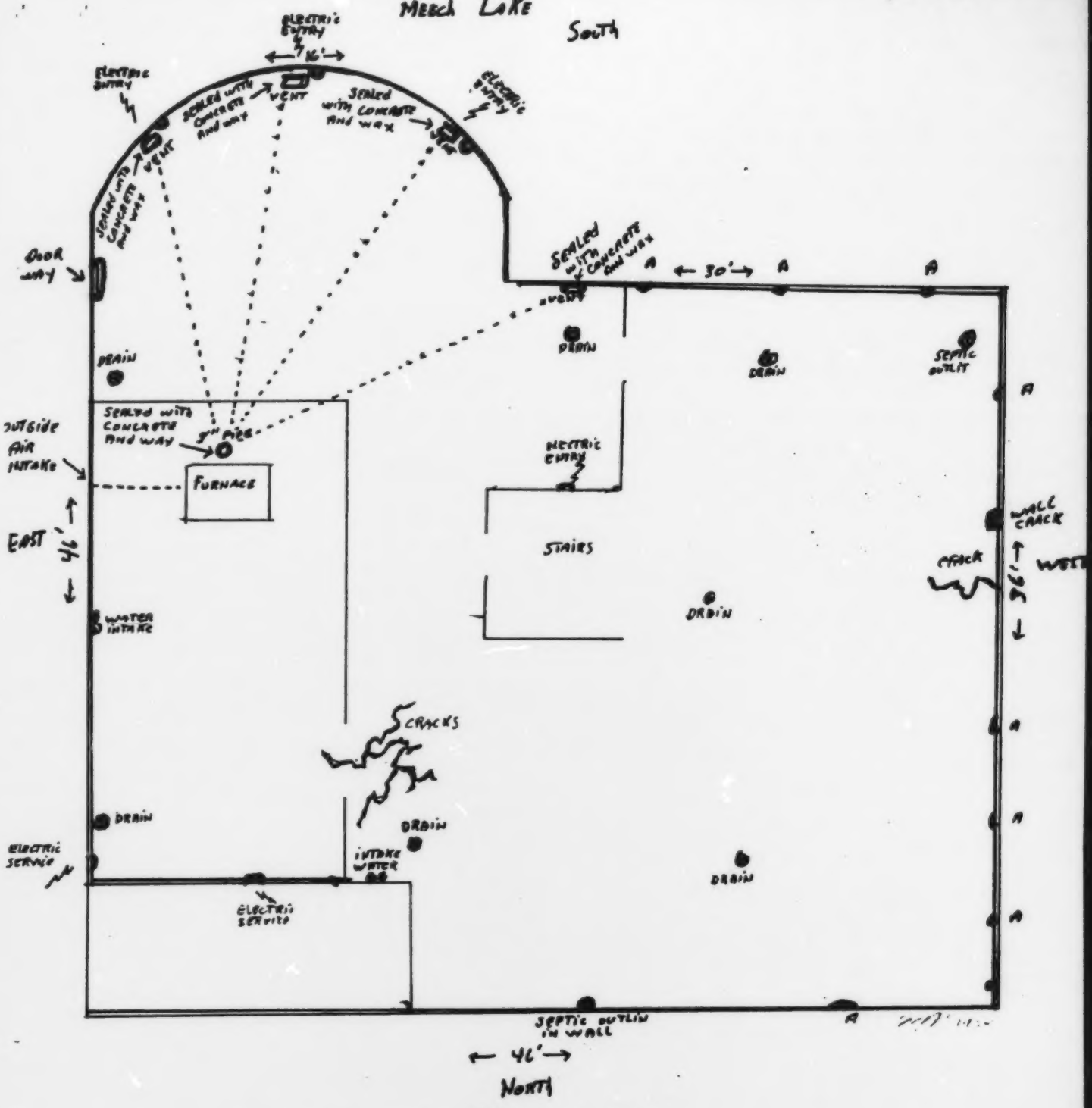
APPENDIX I

DRAWINGS

Unit 1

MEECH LAKE

South



Red indicates where WAY SEALANT was applied

Dotted Line shows air flow and venting under slab

A = APERTURES

Plate # 8

Unit # 3

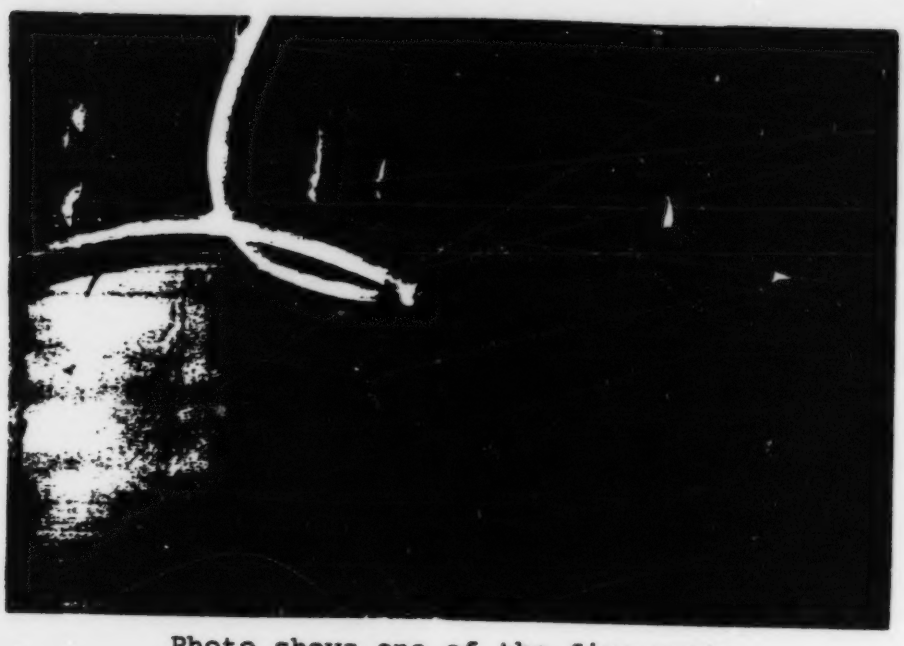


Photo shows one of the five posts as well as cracks in floor and the wall/floor joint.

PLATE # 9 Unit # 3

photo showing angle of cracks in floor

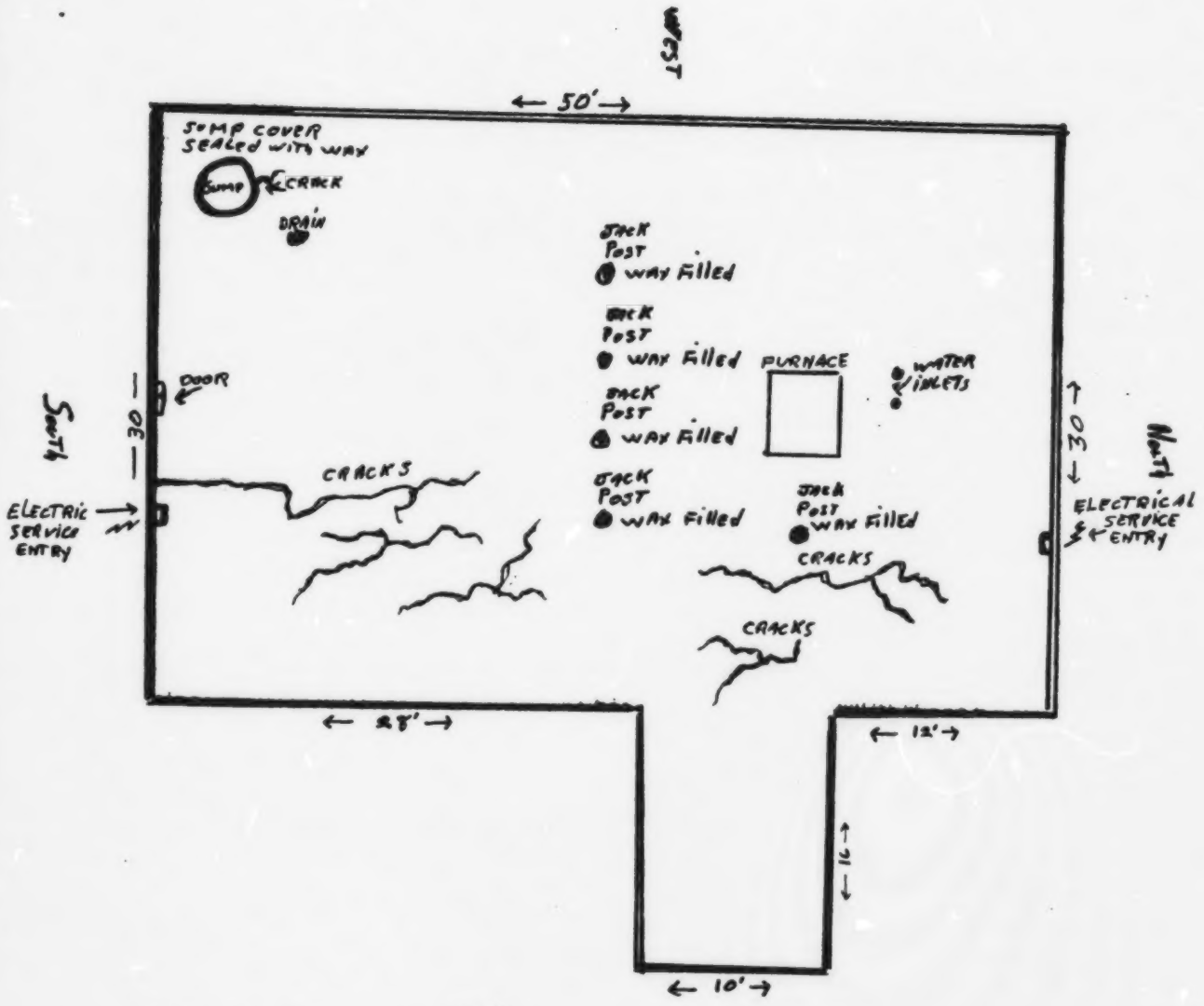
Plate # 10 UNIT 3

Photo shows pits and crack under the waxes transparency.

Aug 20 1990

UNIT III

KEMPVILLE ONT.

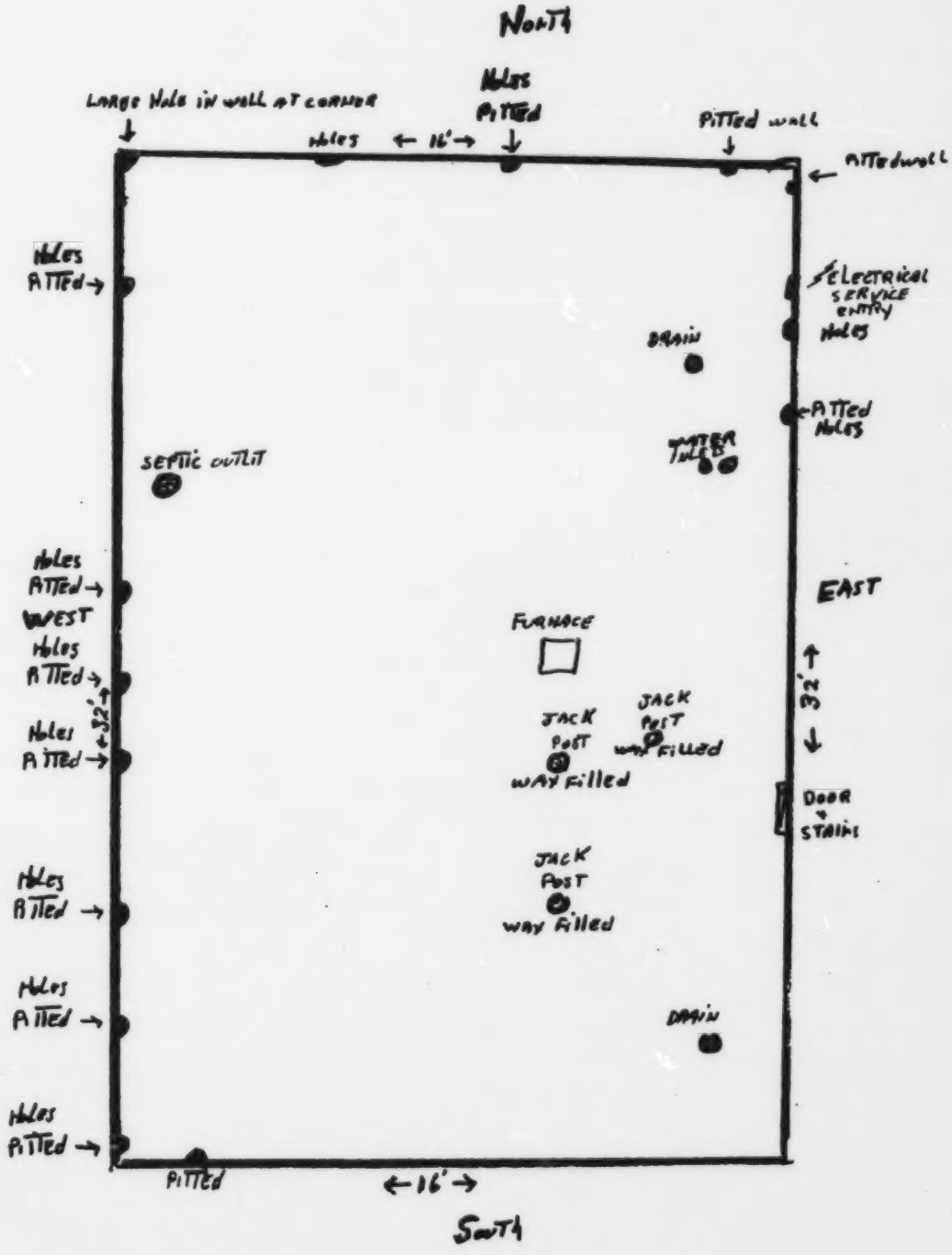


RED INDICATES WHERE WAX SEALANT WAS APPLIED

UNIN II

GLOUCESTER ONT

Aug 20 1990



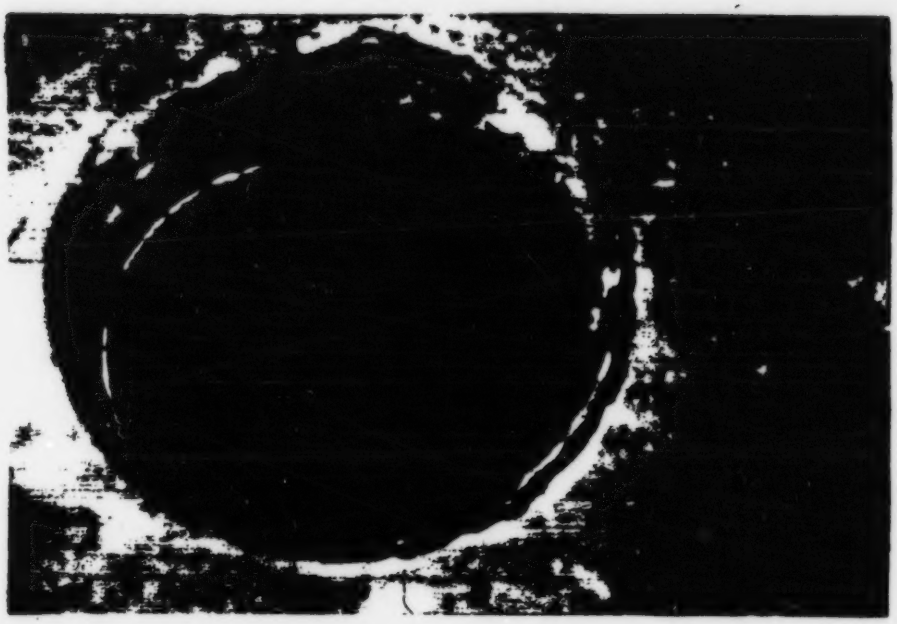
Red indicates where WAX SEALANT was applied

APPENDIX II

PHOTOS

Plate # 1

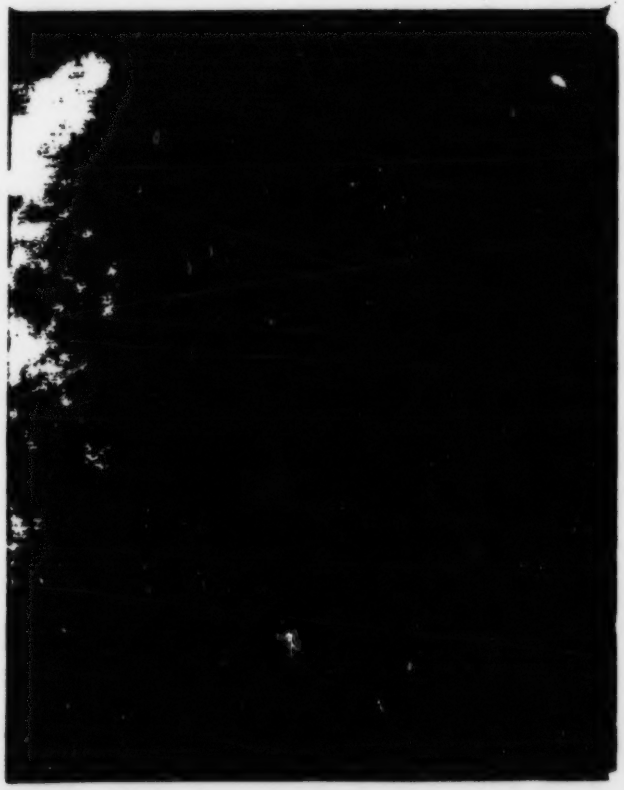
UNIT # 1



Looking down into the main air 8" intake pipe that leads to the four vent outlets in south wing.

Plate # 2

UNIT # 1



Looking through 8" pipe leading to vents using flash camera.
Note rust.

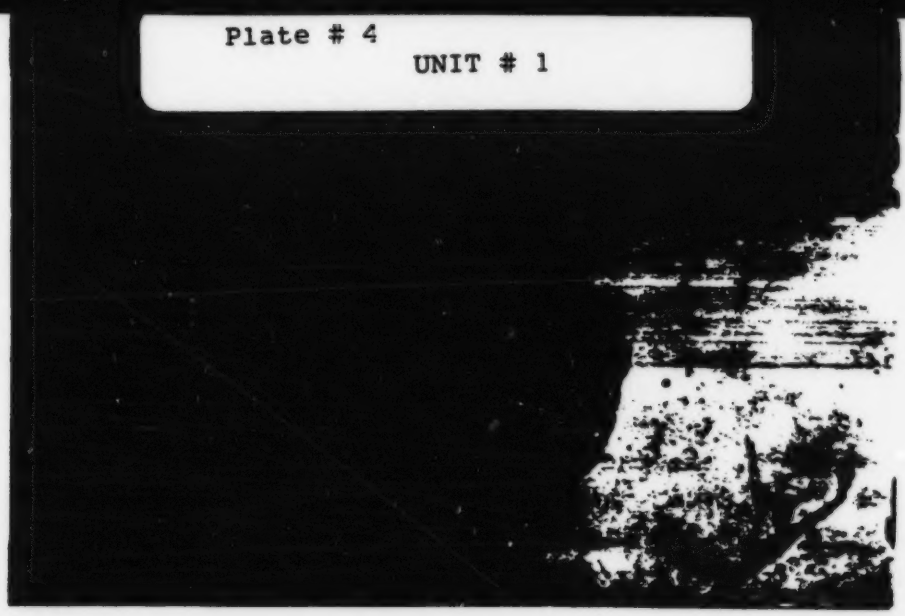
Plate # 3

UNIT # 1

Looking down at intake after sealed with concrete, then sealed with wax.

Plate # 4

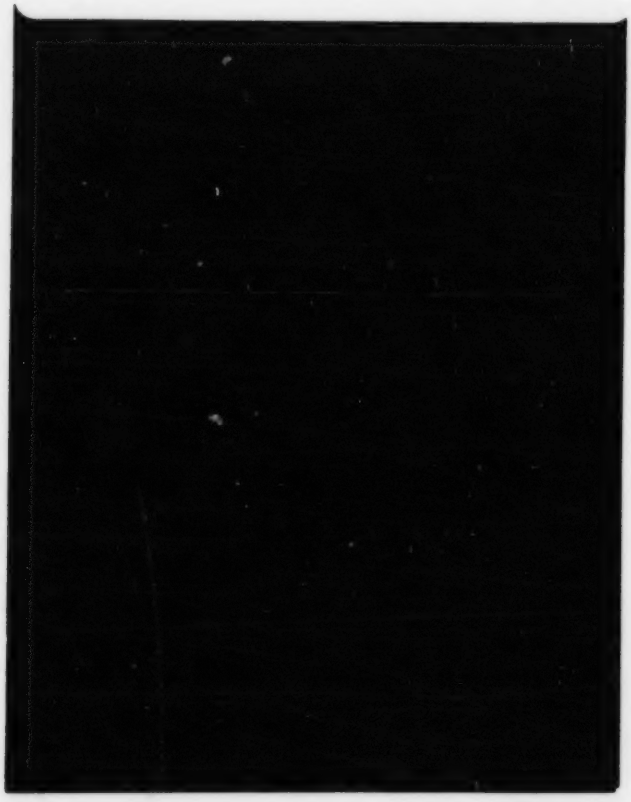
UNIT # 1



Tar paper is slit behind studded wall in preparation to reeive liquid wax application.

Plate # 5

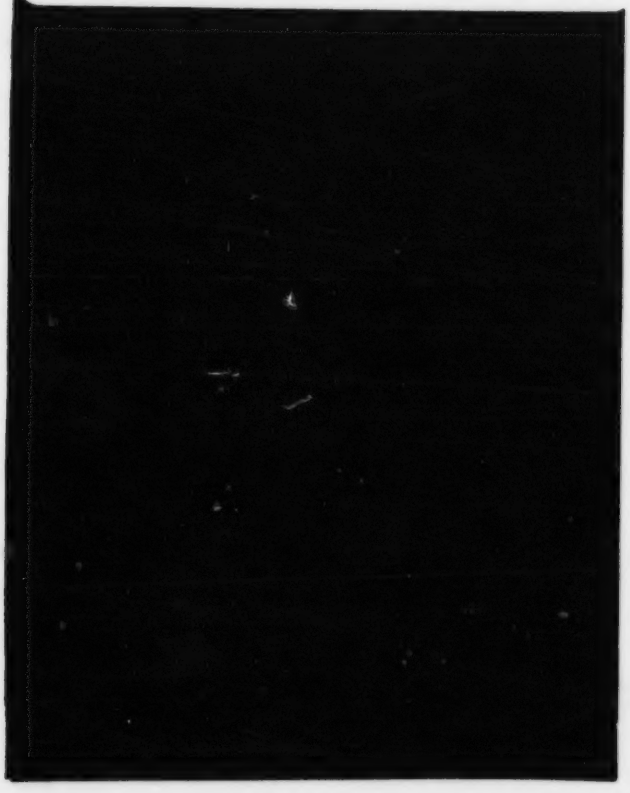
UNIT # 1



Same wall after receiving wax along face of stud and behind tar paper. Note sealed vent.

Plate # 6

UNIT # 1



Flanges removed from all vent outlets after discovering rust. Sealed in same way as air intake

PLATE # 7 UNIT #1

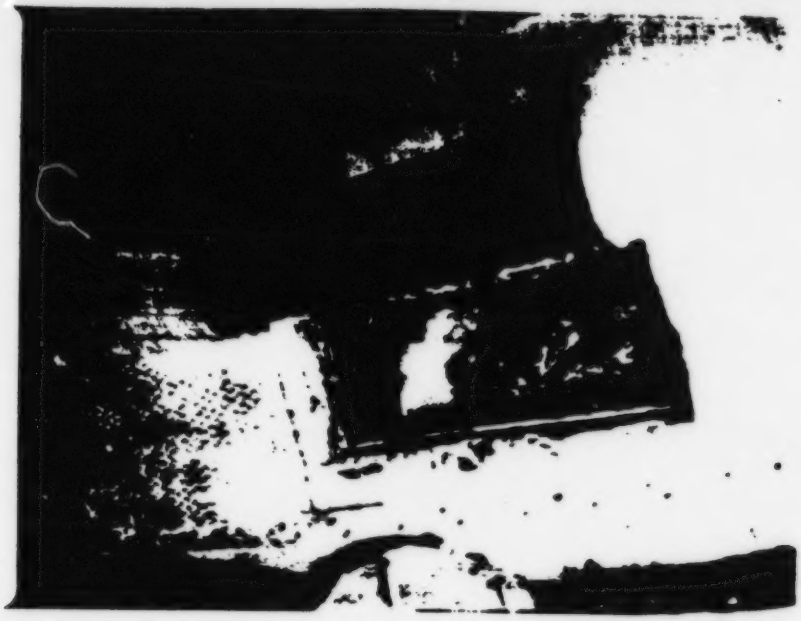


Photo showing carpet peeled back to expose vent and wall/floor joint.

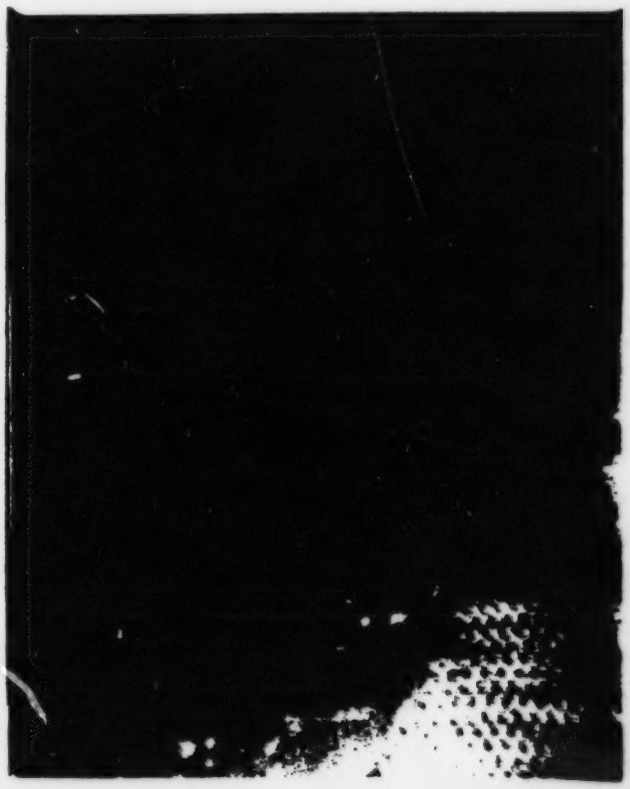
Plate # 8

UNIT # 1

Lower section of wall removed to expose wall/floor joint. Note the loose caulking replaced with wax.

Plate # 9

UNIT # 1



Concrete filled vent

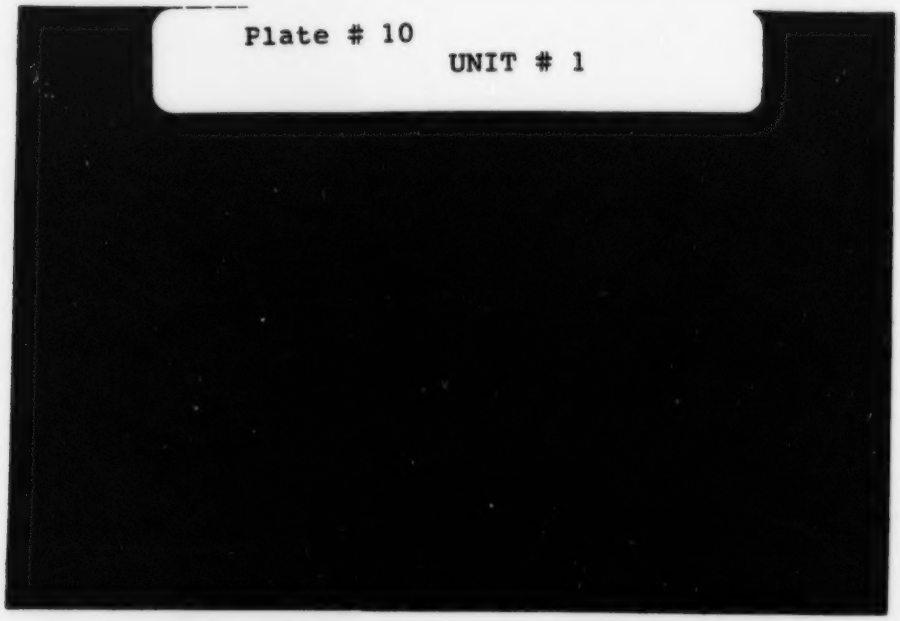


Photo showing close up of complete sealing in front and behind wall studs.

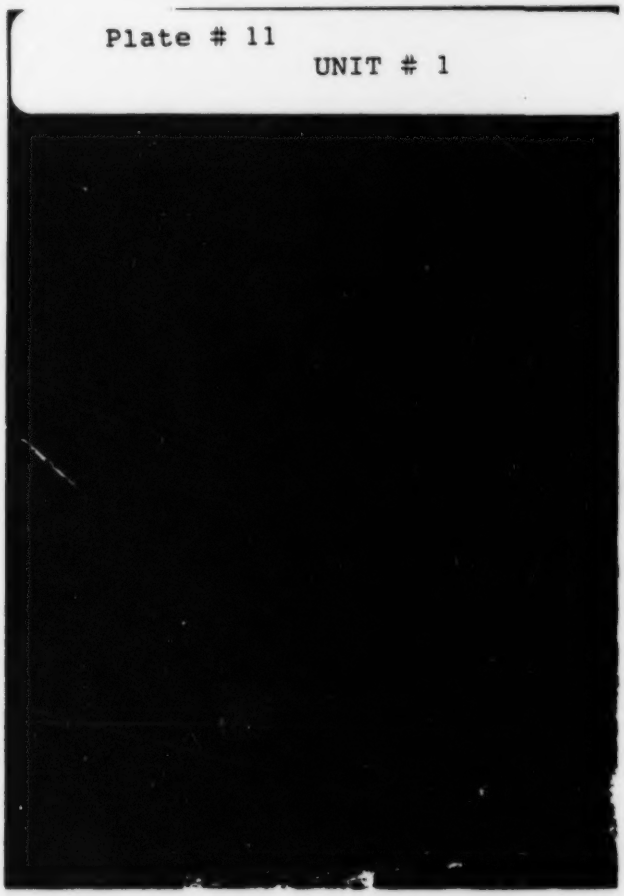


Photo showing section of wall replaced after wax sealant was completed.

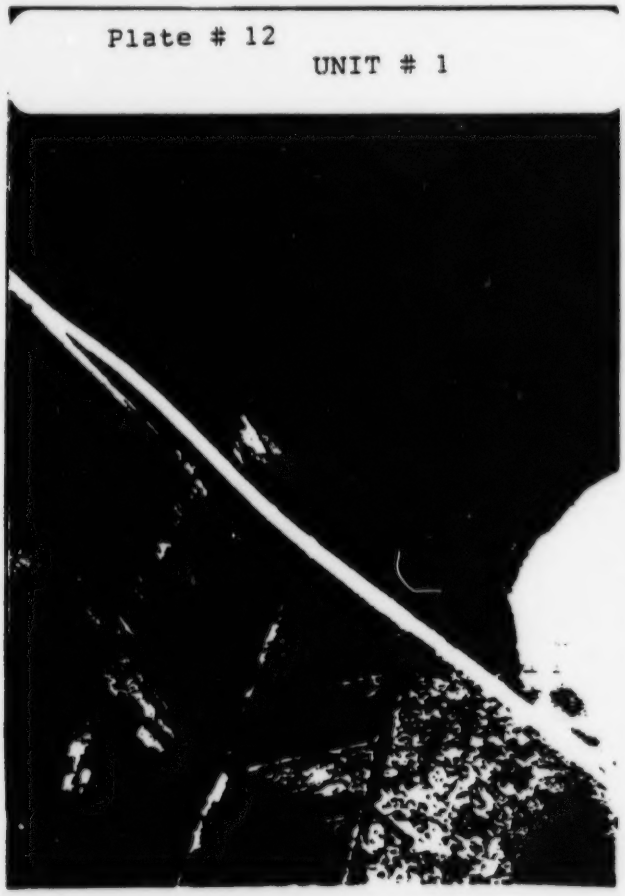


Photo showing removal of one inch plywood from lower section of a wall to expose wall/floor joint.

Plate # 15

UNIT # 1

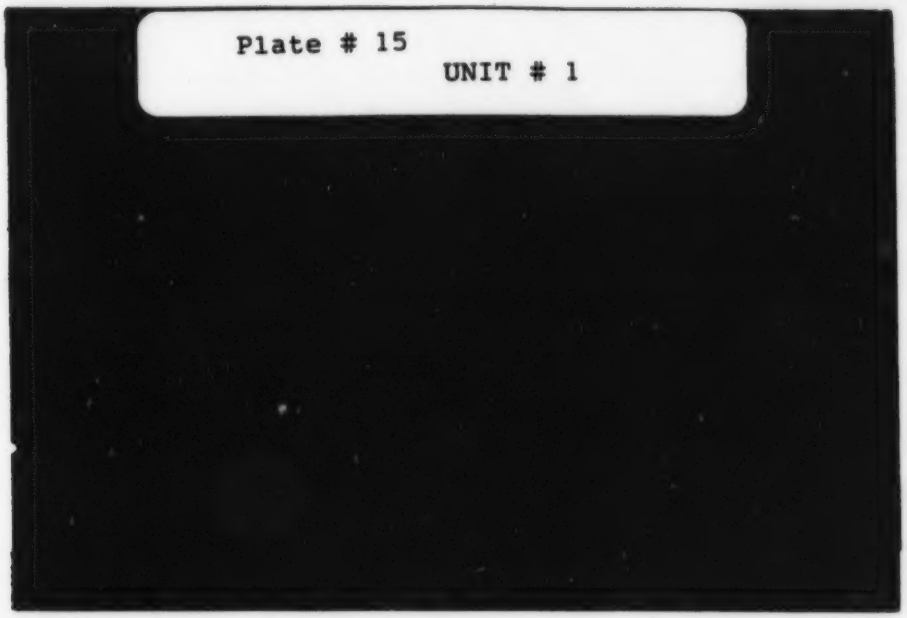


Photo showing one of the drains that was discovered under a carpet.

Plate # 13

UNIT # 1

One of the septic outlets. Note the large sealed gap around pipe leading into the wall.

Plate # 14

UNIT # 1

Photo showing one of the opened drains hidden under the carpet.

This drain was sealed.

Photo showing unfinished studded wall prior to wax sealant being applied. A gas mask was required.

Photo showing crack and wall/floor joint being sealed with caulking gun. Heavy dust required gas mask.

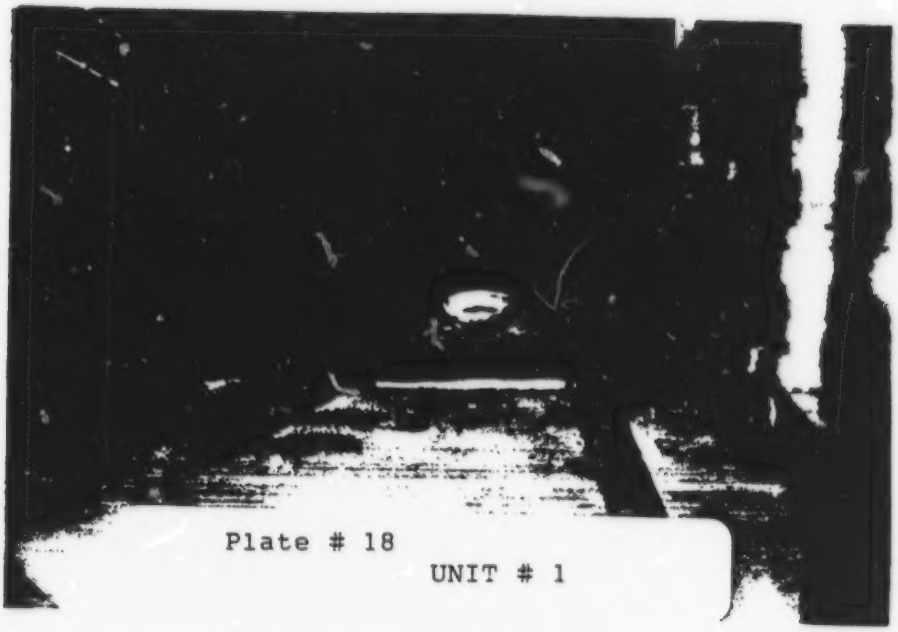


Photo showing drain pipes along the floor level. A large gap was filled around pipe at base of floor.

Photo shows wax sealant along the wall/floor joint being applied with a slab of wax and a torch.

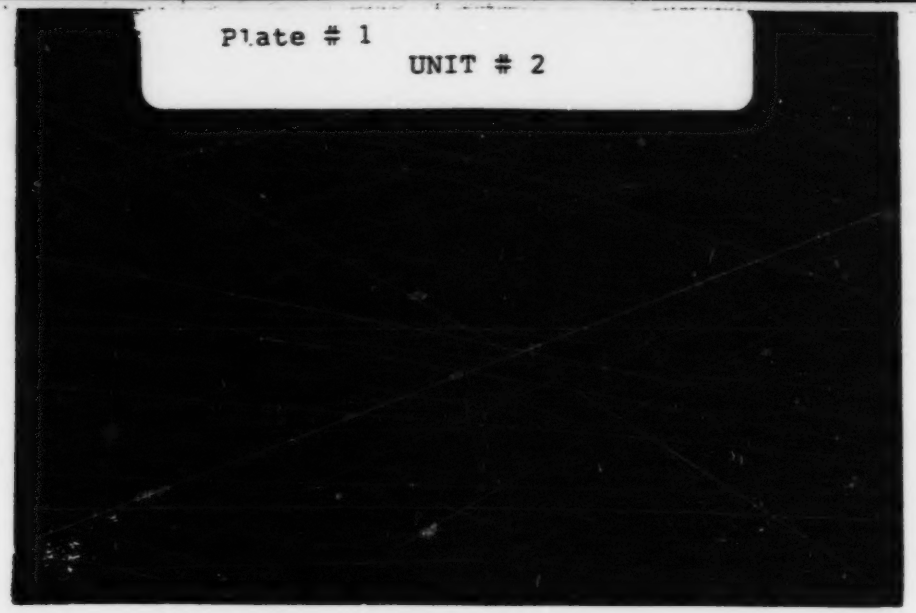
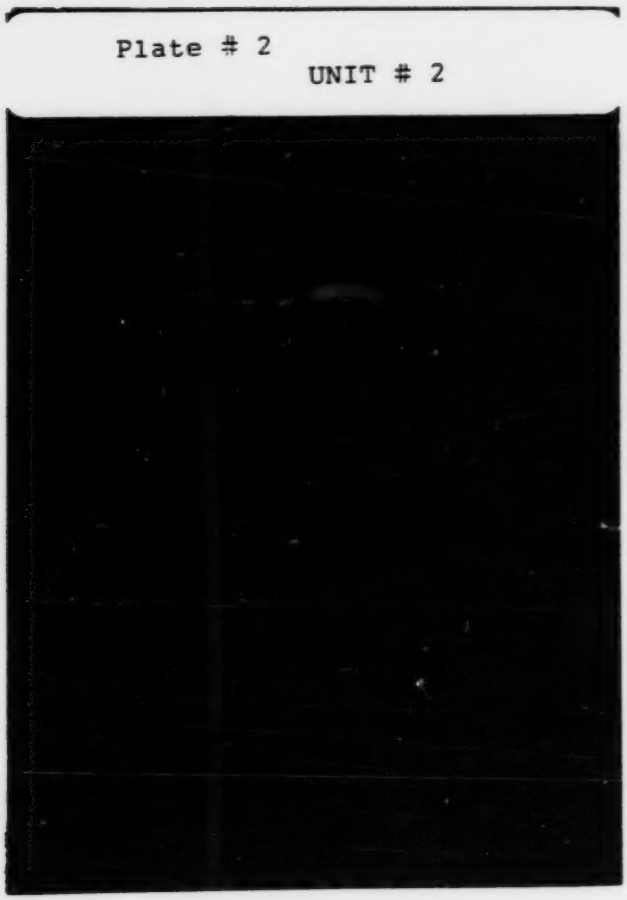
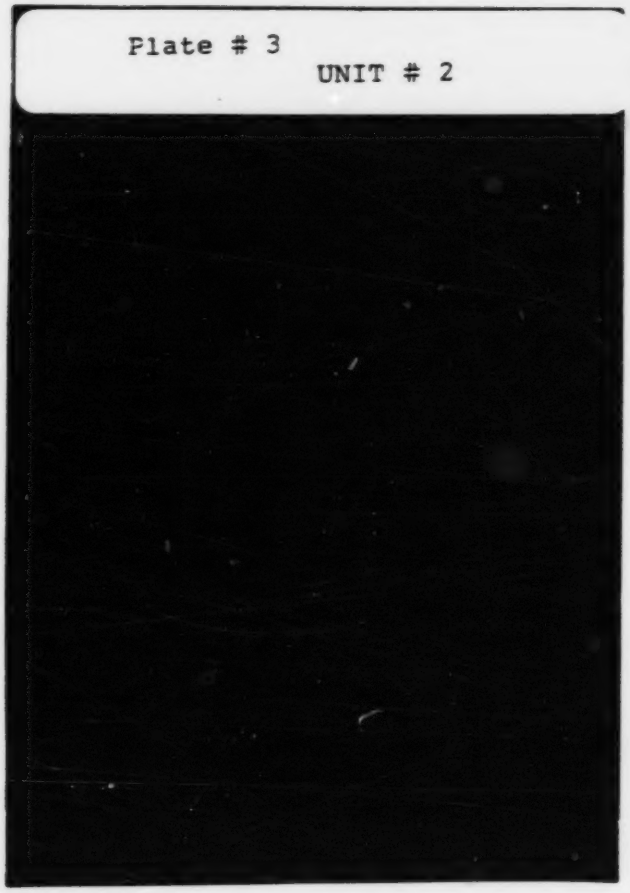


Photo showing sealed wall/floor joint.



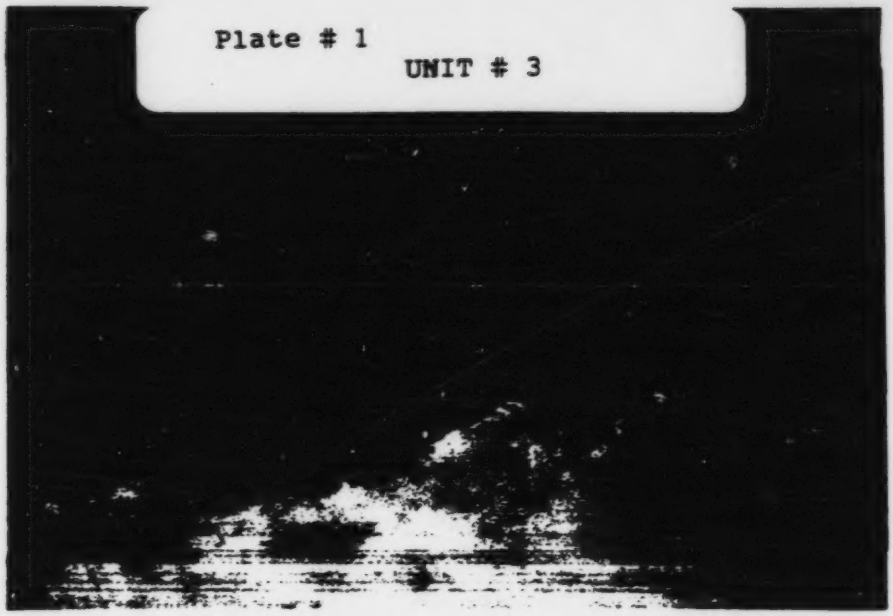
Wall/floor joint after the wax was applied. Wax was pressed in the holes by hand then torched.



Close up of wall/floor joint at corner. Note deep holes in wall.

Plate # 1

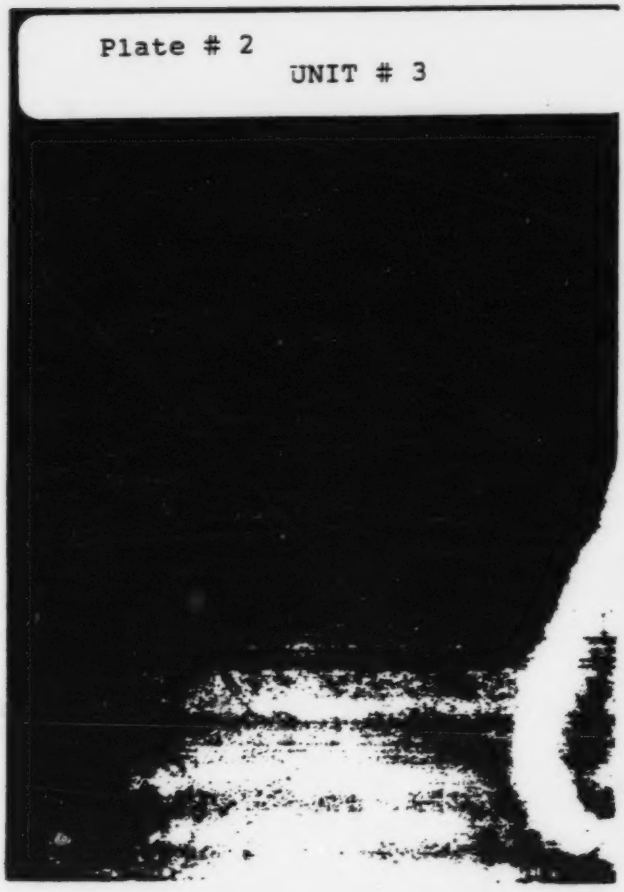
UNIT # 3



Rim of sump hole is built up of the wax sealant in preparation for the sump hole cover. Crack sealed.

Plate # 2

UNIT # 3



This photo shows a 18" corrugated steel pipe used for a sump hole.
Note crack at centre right of hole.

Plate # 3

UNIT # 3

Sump cover is presses onto wax buildup on rim then sealed shut. Note space around pipe entry is sealed also.

Plate # 5 Unit # 3

Plate # 4 Unit # 3

This photo shows two plastic water hoses going into the concrete floor.

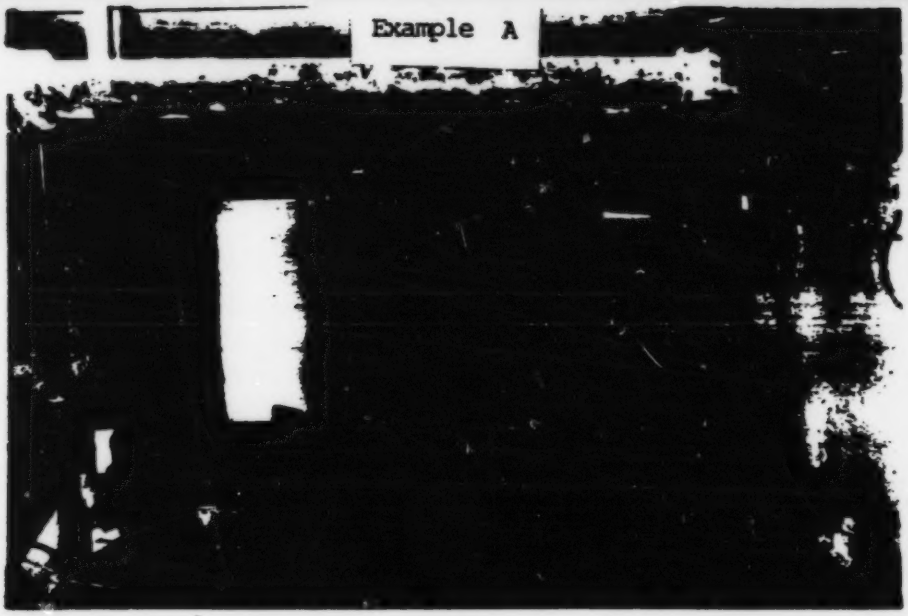
The finger in this photo points to the cold-pour line which may have been one of the entry points.

plate # 6 Unit # 3

Photo shows one of the jack post's being filled with wax. Note crack sealed at bottem of photo.

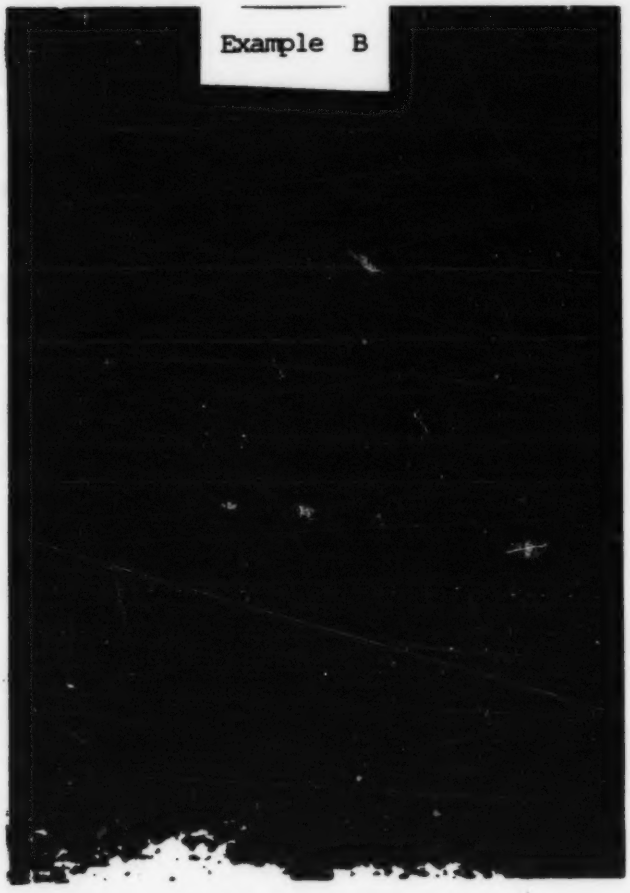
Plate # 7 Unit # 3

Photo showing hot liqued seal along crack. Was smothed with a putty knife.

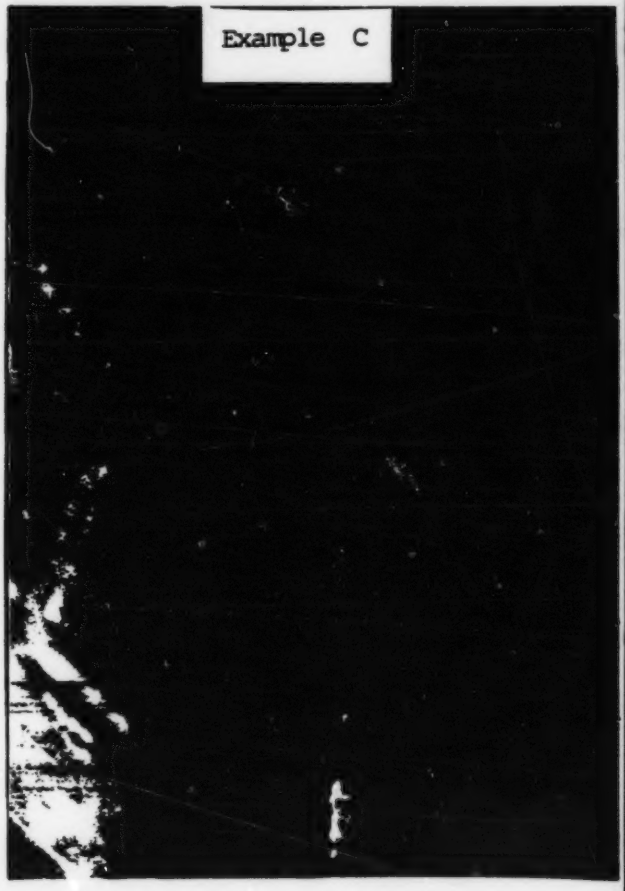


Difficult basement to seal : Dirt floor Multiple piping, Hot water tank under 4" of dirt, Moisture at base of wall.

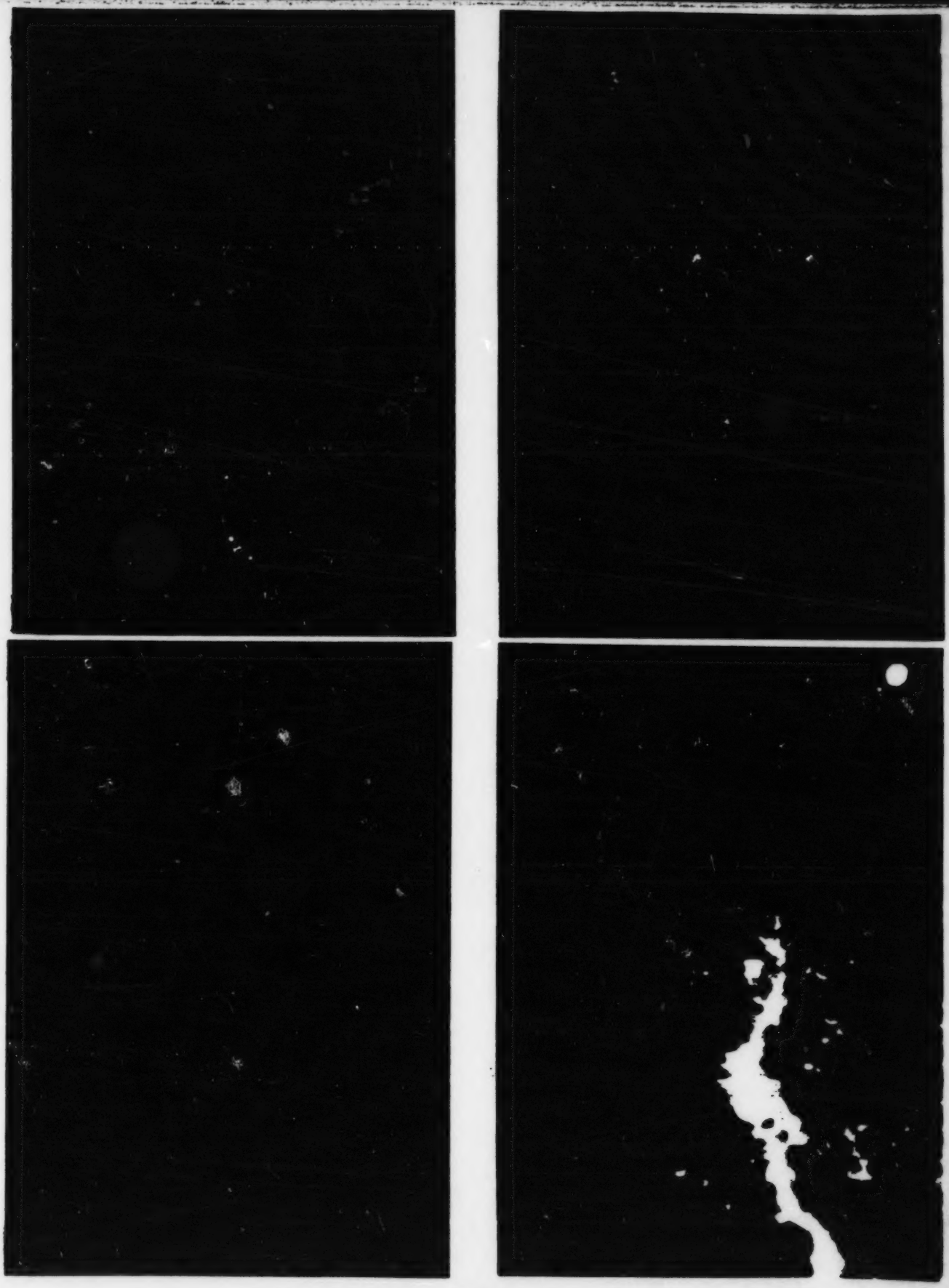
No cover for sump hole, Many service entry's, Note heater on wall at left to prevent moisture. Needs excavating.



Example: Note growth in wall/floor joint Note crack at right angle to wall. Note moisture.



Example: External wall/floor joint gap. Note crack running parallel to wall/floor joint.



EXAMPLE D

Photo shows before and after two blends of wax sealant were applied with the use of a torch.

APPENDIX III

RAW DATA

STRUCTURE # 1

THIS HOME IS LOCATED IN THE MEECH LAKE AREA IN QUEBEC. PREVIOUS TEST HIGHS SHOWED LEVELS OF 68 PCI/L IN DECEMBER OF 1988. SINCE THAT TIME THE HIGHEST RECORDED LEVEL PROVED TO BE IN VICINITY OF 18 PCI/L, WITH AN AVERAGE OF 16 PCI/L SEEMING TO BE THE CONSTANT.

ON OCTOBER 3, 1989, THIS HOUSE WAS CLOSED IN ORDER TO MIMIC WINTER CONDITIONS. THIS IS A STANDARD PRACTICE IN ALL TESTS ALLOWING US TO FIND THE HIGHEST POSSIBLE RADON LEVELS. ON OCTOBER 4, 1989, OUR FIRST CASE STUDY TEST BEGAN USING A WL MONITOR TO DETERMINE THE RADON DAUGHTER CONCENTRATIONS. WEATHER CONDITIONS WERE AS FOLLOWS:

1 HIGH TEMPERATURE = 10 DEGREES CELSIUS
2 LOW TEMPERATURE = 0 DEGREES CELSIUS, NIGHT FROST
3 AVERAGE WIND = 17 KILOMETERS PER HOUR FROM THE WEST
4 45% RELATIVE HUMIDITY
5 CLEAR SKIES
6 AT 8:00 P.M. THE PRESSURE WAS 108 AND RISING, AND IT WAS 7 DEGREES CELSIUS.

UPON COMPLETION OF THIS INITIAL TEST THE REBULTS WERE AS EXPECTED, 16.3 PCI/L. THIS LEVEL IS CONSIDERED TO BE ACCURATE AS THE EQUIPMENT USED WAS CALIBRATED WITH A KNOWN CHECK SOURCE.

STRUCTURE # 2

THIS STRUCTURE IS LOCATED IN GLOUCESTER, ONTARIO. TRADITIONALLY THIS AREA HAS BEEN PROVEN TO HAVE A LOW CONCENTRATION OF RADON. BASED UPON OUR EXPERIENCE WITH HOMEOWNERS, WE HAVE BECOME AWARE THAT SOME ARE NOT HAPPY WITH EVEN TRACE LEVELS. IT SHOULD BE NOTED HERE THAT SOME LEVEL OF RADON WILL ALWAYS BE PRESENT IN A STRUCTURE, AS IT IS FOUND IN LOW LEVELS IN OUTSIDE AIR.

ON OCTOBER 8, 1989 THIS HOUSE WAS CLOSED TO MIMIC WINTER CONDITIONS. TESTING COMMENCED AT 9:30 ON OCTOBER 9, 1989. THE WEATHER CONDITIONS WERE AS FOLLOWS:

1 HIGH TEMPERATURE = 10 DEGREES CELSIUS
2 LOW TEMPERATURE = -3 DEGREES CELSIUS
3 AVERAGE WIND = 11 KILOMETERS PER HOUR FROM THE NORTH WEST
4 55% RELATIVE HUMIDITY
5 CLEAR SKIES
6 AT 8:00 P.M. THE PRESSURE WAS 102.0 KP AND RISING. IT WAS 3 DEGREES CELSIUS.

ON OCTOBER 10, 1989 THE TEST ENDED EXACTLY 24 HOURS AFTER COMMENCEMENT AND PROVED TO HAVE A LEVEL OF 2.4 PCI/L. ALTHOUGH THIS IS A HIGHLY DESIRABLE LEVEL, WE WILL APPLY THE WAX IN THE HOPES OF ACHIEVING A NEAR ZERO.

STRUCTURE # 3

OUR THIRD CHOICE WAS AGAIN A RESIDENTIAL DWELLING, THIS TIME IN THE KEMPTVILLE AREA. CHOSEN PRIMARILY FOR IT'S UNFINISHED BASEMENT, IT WAS DECIDED THAT A NEW HOME SHOULD ALSO BE INCLUDED IN THIS STUDY. THIS HOME WAS LESS THAN 1 YEAR OLD. AN INTERESTING TWIST WAS NOTED PRIOR TO TESTING. THIS HOME ALREADY HAD AN AIR EXCHANGER IN OPERATION. THE RESIDENT WAS INSTRUCTED TO TURN THE AIR EXCHANGER OFF FOR 12 HOURS AS WELL AS CLOSE UP THE HOUSE. A TWENTY FOUR HOUR TEST WAS RUN UNDER THESE CONDITIONS AND A FURTHER 24 HOUR TEST WAS RUN IMMEDIATELY FOLLOWING THE FIRST TEST WITH THE AIR EXCHANGER ON. TESTING BEGAN ON OCTOBER 22, 1989 AT 1:00 P.M.. WEATHER CONDITIONS REMAINED RELATIVELY CONSTANT THROUGHOUT THIS TWENTY FOUR HOUR PERIOD.

1 HIGH TEMPERATURE = 11 DEGREES CELSIUS
2 LOW TEMPERATURE = 1 DEGREE CELSIUS
3 AVERAGE WIND = 15 KILOMETERS FORM THE WEST
4 66% RELATIVE HUMIDITY
5 CLEAR SKIES
6 AT 8:00 P.M. THE PRESSURE WAS 101 KP AND RISING

THE RECORDED LEVEL FOR TEST NUMBER ONE HAS 4.1 PCI/L, WHILE THE LEVEL FOR THE SECOND TEST WAS 3.9 PCI/L. THIS SLIGHT VARIATION INDICATES TO US THE IMPORTANCE OF BALANCING AN AIR EXCHANGER TO CREATE A POSITIVE PRESSURE. THIS PARTICULAR ONE OBVIOUSLY WAS NOT, OR WE WOULD HAVE SEEN A DRAMATIC DROP IN THE RADON CONCENTRATION.

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RADON
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OF
CANADA
724-1998

December 13, 1989

Universal Waxes
91 Drummond Street,
Perth, Ontario,

ATTENTION: MR. W. NELSON

Dear Mr. Nelson,

Although neither you nor Canada Mortgage and Housing expected to hear from me at this stage of the project, I felt compelled to offer my congratulations! Of course I am referring to the Meech Lake structure.

IN REVIEW:

DATE	METHOD	LEVEL
DECEMBER 2, 1988	CHARCOAL	64.4 pCi/l
MAY 13, 1989	WL MONITOR	6.5 pCi/l
MAY 14, 1989	WL MONITOR	9.5 pCi/l
May 14 & 15 1989	CHARCOAL	35.8 pCi/l
MAY 15, 1989	WL MONITOR	49.0 pCi/l
MAY 21, 1989	CHARCOAL	16.8 pCi/l
NOTE: AT THIS POINT YOU BECAME INVOLVED.		
OCTOBER 3, 1989	WL MONITOR	16.3 pCi/l
OCTOBER 10, 1989	WL MONITOR	11.0 pCi/l
OCTOBER 14, 1989	WL MONITOR	9.0 pCi/l
DECEMBER 13, 1989	WL MONITOR	3.9 pCi/l

SUCCESS

With the exceptions of May 13 and May 14, 1989, all levels recorded were consistently above 16 pCi/l. The reason for these two discrepancies was that only a quick one hour test was completed in each instance. In addition to these listed results, a number of unrecorded grab samples were conducted throughout the year, each falling in the range of 16 pCi/l to 19 pCi/l.

In conclusion, there is a direct relationship between the drop in this structure's levels and the work performed by your people. A tip of the hat to what will undoubtedly by a prosperous career in radon mitigation.

Merry Christmas
and a Healthy
New Year,

B.T. Reddie

Barry Reddie
President

NOVEMBER 25. 1989

UNIVERSAL WAXES
91 DRUMMOND STREET WEST
PERTH, ONTARIO

ATTENTION: MR. W. NELSON

DEAR MR. NELSON,

THE PURPOSE OF THIS LETTER IS TO RELATE TO YOU MY OPINION OF THE PROCESS OF APPLYING YOUR WAX SEALANT TO EXISTING STRUCTURES FOR THE PURPOSE OF THE EXCLUSION OF RADON GAS.

AT THE TIME OF WRITING, WE ARE APPROXIMATELY HALFWAY FINISHED WITH OUR PROJECT FUNDED THROUGH C.M.H.C. IN MY OPINION, THIS SYSTEM WILL WORK ONLY IF THE WAX IS APPLIED BY A TRAINED PROFESSIONAL THAT IS DEDICATED TO PERFORMING A 100% SEAL OF ALL ENTRY POINTS. ANY LESS THAN A 100% SEAL WILL NOT BE SUFFICIENT IN MOST CASES TO LOWER THE STRUCTURE S RADON LEVEL.

IN CONCLUSION, ALTHOUGH THIS MAY PROVE TO BE AN INEXPENSIVE AND EFFECTIVE MEANS OF CONTROLLING RADON, I AM SURE THAT YOU WILL AGREE THAT IT IS BEST AT THIS TIME TO WAIT UNTIL THE COMPLETION OF THIS PROJECT TO GIVE MY FULL ENDORSEMENT.

SINCERELY,

B.T. Reddie

BARRY REDDIE
PRESIDENT

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RADON
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OF
CANADA
724-1998

Nov 29-1989

UNIVERSAL WAXES
P.O. BOX 22
MABERLY, ONTARIO
KOH 2B0

ATTENTION: MR. W. NELSON

DEAR MR. NELSON,

THIS LETTER WILL SERVE TO INFORM YOU OF OUR FINDINGS WITH REGARDS TO THE SEALING PROPERTIES OF YOUR WAX PRODUCT, AND IT'S EFFECT ON THE ELIMINATION OF RADON GAS FROM WITHIN AN EXISTING STRUCTURE.

AS YOU ARE AWARE, WE HAVE SENT YOUR FIRM INTO TWO HOMES TO SEAL THE UNFINISHED BASEMENT AREA AFTER WE HAD FIRST TESTED AND RECORDED THEIR LEVELS OF RADON. UPON COMPLETION OF YOUR WORK, WE RETESTED THESE SAME HOMES. I AM PLEASED TO INFORM YOU THAT AS A RESULT OF THIS PRELIMINARY STUDY THE RADON LEVELS HAVE DROPPED TO 50% OF THE INITIAL TEST RESULTS IN ONE HOME, AND 60% IN THE OTHER.

THERE IS NO DOUBT IN MY MIND THAT THE LOCATING OF ADDITIONAL ENTRY POINTS AND THE SEALING OF SAME WILL INDEED RESULT IN AN EVEN LOWER READING.

CONGRATULATIONS,

B.T. Reddie

BARRY REDDIE
PRESIDENT

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RADON
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CANADA
724-1998

October 29, 1990

Universal Waxes
91 Drummond Street West
Perth, Ontario
K7H 2K6

ATTENTION: MR. W. NELSON

Dear Mr. Nelson,

It is with great pleasure that I write this letter.

As you are aware, Radon Analysis of Ottawa-Carleton has in the past year, been jointly involved with your firm and Canada Mortgage and Housing in a project to test, seal, and re-test homes with regards to radon gas. Your creation of a wax blend sealant out performed my highest expectations as a permanent bond.

I have no hesitation in recommending your procedure to any homeowner who finds that they have a problem with excessive radon levels within their home.

Finally, it has been a real pleasure working with the members of your firm who have demonstrated to me a real dedication to their work.

Sincerely,

B.T. Reddie

Barry Reddie
President
Radon Analysis of
Ottawa-Carleton

A PRESENTATION TO CANADA MORTGAGE AND HOUSING CORPORATION

FROM

RADON ANALYSIS OF OTTAWA-CARLETON

March 30. 1990

The following contains our phase three report regarding the re-testing of specific structure that relate to Application File # 6521-10/89.

At this stage, it was the duty of Radon Analysis of Ottawa-Carleton to re-test the homes mentioned in phase two of this report, after the sealing compound was applied by Universal waxes.

Structure # 1

The house located in Meech Lake was perhaps the most challenging of the three homes chosen. It's unusual construction allowed for some awkward points of entry of radon gas. Testing commenced on March 26, 1990, at 9:00 a.m. and was completed 24 hours later.

1 High temperature = .1 degree Celsius.
2 Low temperature = -10.7 degrees Celsius.
3 Average wind = 23 kilometers per hour from the north north west.
4 Relative humidity = H 74% L 27%
5 High pressure = 101.4 Kilopascals Low pressure = 100.0 Kilopascals Average = 100.7 Kilopascals.

Upon completion of this test the level was down from 16.3 pCi/l to 4.4 pCi/l. Although this represented a 73% reduction, our aim of reaching a level somewhere below 4 pCi/l was not achieved. Universal Waxes returned to search out any area that may have been missed.

Structure # 2

Initially the house in Gloucester had a radon level of just 2.4 pCi/l. Sealing took place by Universal Waxes, and Radon Analysis of Ottawa-Carleton returned to test on March 23, 1990, at 7:00 p.m. The test lasted for twenty four hours under the following weather conditions...

1 High temperature = -1 degree Celsius.
2 Low temperature = -8 degrees Celsius.
3 Average winds = 11 kilometers from the West South West.
4 Relative humidity = High 92% Low = 33%
5 The skies were sunny.
6 The average pressure was 101 Kilopascals.

Upon completion of the testing, the radon level recorded was .02 pCi/l. Additional re-sealing was unnecessary.

Structure # 3

The third and final home was located in the Kemptville area. Testing began at 10:00 a.m. on March 28, 1990 and also lasted 24 hours. The weather conditions follow.

1 High temperature = 2.9 degrees Celsius.
2 Low temperature = -7 degrees Celsius.
3 Average winds = 19.3 kilometers from the West North West.
4 The relative humidity = High 79% Low 24%
5 The skies were sunny.
6 The average barometric pressure was 101.5 Kilopascals.

At the end of this test, the level had been reduced from 4.1 pCi/l to .61 pCi/l.

June 28, 1990

The following is the final report issued by Radon Analysis of Ottawa-Carleton for Application File # 6521-10/89.

The purpose at this stage was to determine if the wax blend could withstand the freeze/thaw cycle.

Structure # 1

The home in the Meech Lake area was re-tested on June 20, 1990 starting at 7:00 p.m., and continued for twenty four hours.

The weather conditions were as follows.

1 High temperature = 18.8 degrees Celsius.
2 Low temperature = 13.6 degrees Celsius.
3 Average wind = 8.7 kilometers from the East.
4 Average relative humidity = 91.5%.
5 Skies were overcast and rainy.
6 Average barometric pressure = 99.53 Kilopascals .

This time the level was down to 2.4 pCi/l. Obviously the return trip and subsequent sealing of additional apertures by Universal Waxes was sufficient to aid in achieving our below 4 pCi/l objective.

Structure # 2

Re-testing of the Gloucester house took place on June 19, 1990 at approximately 8:30 a.m. and lasted for twenty four hours.

1 High temperature = 20.1 degrees Celsius.
2 Low temperature = 14.3 degrees Celsius.
3 Average winds = 13.9 kilometers from the West
4 Average relative humidity = 84%.
5 The skies were cloudy with some drizzle.
6 Average barometric pressure was 99.31 Kilopascals.

We were pleased to observe that the level continued to remain extremely low at .02 pCi/l.

Structure # 3

Our final test was in the Kemptville area home. The test began at 11:00 a.m. on June 25, 1990, and lasted for 24 hours. The weather conditions were as follows.

1 High temperature = 25 degrees Celsius
2 Low temperature = 14 degrees Celsius
3 Average winds = 11 Kilometers from the west
4 Relative humidity = 40%
5 Clear skies
6 At 6:00 p.m. the barometric pressure = 101.4 Kilopascals and steady.

Upon completion, the level was .93 pCi/l, up slightly from the previous low of .61 pCi/l. This represents a slight increase of .32 pCi/l over the previous test.

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CONCLUSION

We at Radon Analysis of Ottawa-Carleton are of the opinion that the blend of waxes created by Universal Waxes represents an important step in the reduction of radon gas in many types of structures. It is however, important to stress the importance of sealing every possible aperture, as we saw with the Meech Lake home where return trips were necessary.

As for the physical nature of the sealant, it performed as promised, meeting or exceeding our performance expectations.

The potential for use in new home construction as well as unfinished basements is encouraging but I would hesitate to recommend at this time that it be used in a renovated environment. This is primarily due to the difficulty in applying the wax in sufficient quantity to the hidden points beneath, for example, a raised floor.

B.T. Reddie

Barry Reddie
President
Radon Analysis of
Ottawa-Carleton

R.R. 1
Oxford Station
Ontario. K0G 1T0
13-12-1989

Dear Mr. W. Nelson,

I would like to take this opportunity to thank you most sincerly for the excellent work which you and your associate did on the waxing of the basement floor etc. in my home. I was advised by Brian who did the latest Radon Analysis test that the level of radon gas has been significantly reduced to a minimum which makes for a safe home and is very much appreciated. I would highly recommend your work to anyone.

Best wishes to you & your family for the Christmas season, please convey my best wishes also to Colin & Barry & thank you once again.

Yours sincerly

(Mrs) Margaret Collins

APPENDIX IV

PRODUCT DATA

WILLIAM E. NELSON
CONSULTANT

OFFICE (613) 267-27
HOME (613) 268-250
FAX (613) 267-793

technical information sheet

SAMPLE RD-2172

SAMPLE RD-2172 is a soft, tacky, petroleum wax formulation recommended for applications on mine tailings as a radon gas inhibitor.

PHYSICAL PROPERTIES:

Congealing Point (ASTM D938)		°C	65.6
		°F	150
Needle Penetration (ASTM D1321)	dmm @25°C		100
Kinematic Viscosity (ASTM D445)	cSt @210°C		14
Colour	YELLOWISH BROWN		

THIS PRODUCT IS LISTED ON THE EPA/TSCA INVENTORY OF CHEMICAL SUBSTANCES. MEETS FDA REQUIREMENTS SET FORTH IN 21 CFR 178 .3710 FOR USE IN NONFOOD ARTICLES IN CONTACT WITH FOOD AND IN 21 CFR 172.886 FOR USE IN FOOD.

WILLIAM E. NELSON
CONSULTANT

OFFICE (613) 267-272
HOME (613) 268-250
FAX (613) 267-793

SECTION 1 — MATERIAL IDENTIFICATION AND USE

MATERIAL NAME ▶ RD-2172	PRODUCT CODE: RD-2172	
CHEMICAL NAME: NOT APPLICABLE	CHEMICAL FAMILY: PETROLEUM HYDROCARBON WAX	CHEMICAL FORMULA: NOT APPLICABLE
MOLECULAR WEIGHT: NOT APPLICABLE	CAS REGISTRY NUMBER: NOT APPLICABLE	MATERIAL USE: VARIOUS

SECTION 2 — HAZARDOUS INGREDIENTS

BASED ON DATA AVAILABLE
THIS IS NOT A CONTROLLED PRODUCT AS DEFINED BY THE
CANADIAN HAZARDOUS PRODUCTS ACT (BILL C70)
AND IS NOT HAZARDOUS AS DEFINED BY U.S. OSHA HAZARD
COMMUNICATION STANDARD 29 CFR 1910.1200

SECTION 3 — PHYSICAL DATA

PHYSICAL STATE: GAS ☐ LIQUID ☐ SOLID ☒	ODOUR AND APPEARANCE: NO ODOUR - YELLOWISH BROWN			ODOUR THRESHOLD (PPM): NOT AVAILABLE
VAPOUR PRESSURE (mm Hg): <0.01 @20°C	VAPOUR DENSITY (AIR = 1): >5	EVAPORATION RATE: <0.01 BUTYL ACETATE = 1	BOILING POINT (BP) (°C): > 331°	FREEZING POINT (°C): 66° (ASTM D 938)
% VOLATILE (BY VOLUME): <0.01%	SOLUBILITY IN WATER (20°C): <0.1%	pH: NOT APPLICABLE	SPECIFIC GRAVITY: @25°C 0.92	COEFF. WATER/OIL DIST.: <0.01

SECTION 4 — FIRE AND EXPLOSION DATA

FLAMMABILITY: YES ☒ NO ☐ IF YES, UNDER WHICH CONDITIONS? ▶ *WILL SUPPORT A FLAME ONLY ABOVE THE FLASH POINT - SEE BELOW*

MEANS OF EXTINCTION: *USE WATER FOG, FOAM, DRY CHEMICAL OR CO_2 DO NOT USE A DIRECT STREAM OF WATER.*

SPECIAL PROCEDURES: *USE WATER TO KEEP EXPOSED CONTAINERS COOL.*

FLASHPOINT (°C) (ASTM D92): > 230°	UPPER EXPLOSION LIMIT (% BY VOLUME): 7.0%	LOWER EXPLOSION LIMIT (% BY VOLUME): 0.9%
AUTO IGNITION TEMPERATURE (°C): NOT AVAILABLE	TDG FLAMMABILITY CLASSIFICATION: NOT DANGEROUS	HAZARDOUS COMBUSTION PRODUCTS: CO_2, CO *(see below)

EXPLOSION DATA ▶	SENSITIVITY TO IMPACT: NOT APPLICABLE	RATE OF BURNING: NOT APPLICABLE	EXPLOSIVE POWER: NOT APPLICABLE	SENSITIVITY TO STATIC DISCHARGE: NOT APPLICABLE

SECTION 5 — REACTIVITY DATA

CHEMICAL STABILITY: YES ☒ NO ☐ IF NO, UNDER WHICH CONDITIONS? ▶

COMPATIBILITY WITH OTHER SUBSTANCES: YES ☐ NO ☒ IF NO, WHICH ONES? ▶ *STRONG OXIDIZING AGENTS, e.g. PEROXIDES, CHLORINE*

REACTIVITY, AND UNDER WHAT CONDITIONS: *STABLE*

WILLIAM E. NELSON
CONSULTANT

UNIVERSAL WAXES
PRODUCTS FOR A BETTER ENVIRONMENT

OFFICE (613) 267-272
HOME (613) 268-250
FAX (613) 267-793

SECTION 6 — TOXICOLOGICAL PROPERTIES AND HEALTH INFORMATION

ROUTE OF ENTRY

SKIN CONTACT ☒ SKIN ABSORPTION ☐ EYE CONTACT ☐ INHALATION ACUTE ☒ INHALATION CHRONIC ☐ INGESTION ☐

EFFECTS OF ACUTE EXPOSURE TO MATERIAL: PARAFFIN WAX FUMES REPORTED TO CAUSE DISCOMFORT.
MOLTEN PRODUCT WILL CAUSE BURNS ON CONTACT WITH SKIN.

EFFECTS OF CHRONIC EXPOSURE TO MATERIAL: NO ILL EFFECTS HAVE BEEN DETERMINED

LD_{50} OF MATERIAL SPECIFY SPECIES & ROUTE	LC_{50} OF MATERIAL SPECIFY SPECIES	EXPOSURE LIMIT OF MATERIAL	IRRITANCY OF MATERIAL
NOT AVAILABLE	NOT AVAILABLE	TLV/TWA 2mg/m^3 FOR PARAFFIN WAX FUMES (A.C.G.I.H.)	TLV LIMIT SET TO AVOID POSSIBLE IRRITATION
SENSITIZING CAPABILITY OF MATERIAL	**CARCINOGENICITY OF MATERIAL**	**REPRODUCTIVE EFFECTS OF MATERIAL**	**SYNERGISTIC MATERIALS**
NONE KNOWN	NOT CARCINOGENIC BY STUDIES, TO DATE	EXISTING DATA HAS REVEALED NO REPRODUCTIVE EFFECTS	NONE KNOWN

SECTION 7 — PREVENTIVE MEASURES

PERSONAL PROTECTIVE EQUIPMENT

GLOVES (SPECIFY)	RESPIRATORY (SPECIFY)	EYE (SPECIFY)
AS REQUIRED TO HANDLE HOT MATERIALS	*NO SPECIAL REQUIREMENTS UNDER ORDINARY CONDITIONS OF USE AND WITH ADEQUATE VENTILATION*	*NORMAL INDUSTRIAL EYE PROTECTION PRACTICES SHOULD BE EMPLOYED*
FOOT WEAR (SPECIFY)	**CLOTHING (SPECIFY)**	**OTHER (SPECIFY)**
SPLASH RESISTANT	*SPLASH RESISTANT*	

ENGINEERING CONTROLS (SPECIFY e.g. VENTILATION ENCLOSED PROCESS)
LOCAL EXHAUST OR HOOD RECOMMENDED (FOR MOLTEN MATERIAL)

LEAK AND SPILL PROCEDURE: *RECOVER FREE PRODUCT. KEEP PRODUCT OUT OF SEWERS AND WATERCOURSES BY DIKING OR IMPOUNDING. ALLOW TO SOLIDIFY AND SCRAPE UP.*

WASTE DISPOSAL: *DISPOSE OF IN APPROVED INCINERATOR OR LICENSED DISPOSAL FACILITY. FOLLOW LOCAL REGULATIONS.*

HANDLING PROCEDURES AND EQUIPMENT
NO SPECIAL PROCEDURE OR EQUIPMENT REQUIRED.

STORAGE REQUIREMENTS
STORE NO HIGHER THAN 15°C ABOVE THE MELTING POINT. AVOID DIRECT EXPOSURE TO SUNLIGHT.

SPECIAL SHIPPING INFORMATION
NONE

SECTION 8 — FIRST AID MEASURE

EYE CONTACT: *Immediately wash with fresh water for at least 15 minutes and get medical attention.*

SKIN CONTACT: *Wash contact areas with soap and water. If burned by hot product, cool molten material adhering to skin as quickly as possible and see a physician for removal of adhering material and treatment of burn.*

INHALATION: *Remove victim to fresh air. Seek medical attention.*

IGESTION: *Product is not acutely toxic by ingestion.*

TESTS CONDUCTED BY UNIVERSAL WAXES - NOVEMBER 1989

William Nelson initiated detailed laboratory tests of selected blends. There were 6 mixtures chosen for these tests:

		------Paraffin-----			Melting
Blend #	% Microcryst.	% Slack	% Ordinary	Petrolatum	Point (°C)
1	25	50	0	25	51.7
2	25	0	50	25	54.4
3	25	75	0	0	51.7
4	25	0	75	0	57.2
5(w/polymers)	0	100	0	0	47.8
6	5	0	95	0	48.9

The initial testwork consisted of ladle-shaped (or cup-shaped) with a diameter of 10.5 cm. and a depth of 3 cm. with a wide, curving bottom. The thickness of wax used for each cup was 1.5 cm. A cup was made of each of the 6 blends. Water was poured into the cups and submitted to freeze-thaw cycling for up to 18 cycles to evaluate the integrity of the blends under common environmental temperature variations. The results were as follows:

Blend #	No. of cycles	Observations
1	18	Very good formula; no problems
2	18	Very good formula; no problems
3	3	No good; broke open
4	3	No good; broke open
5	3	No good; broke open
6	18	Very good formula; no problems

The 6 blends were also formed into free-standing blocks of dimensions 10 cm. high by 20 cm long (standing on the 20 cm. edge) with thicknesses of 1.0, 1.5, and 2.0 cm. These blocks were submitted to freeze-thaw cycling to test their physical and geotechnical stability under temperature variations. The results were similar to those of the cups:

Blend #	No. of cycles	Observations
1	18	No cracks, fractures, or problems
2	18	No cracks, fractures, or problems
3	2	All 3 thicknesses developed hair-line fractures
4	3	All 3 thicknesses developed major fractures and separations
5	1	All 3 thicknesses broke and crumbled
6	18	No cracks, fractures, or problems

As a result, 3 of the 6 blends were identified for testing in homes.

Blend #	Adjusted Blend #
1	1
2	2
6	3